MTC TravInfo® Contractor

Data Fusion
Concept of Operations

(Revised Final)

Deliverable #3-4a

Functional Requirement 3.3.1

July 20, 2001

Revision History			
Date	**Author**	**QC**	**Notes**
March 23, 2001	Martin Falck	John Wintermute	Draft version
April 23, 2001	Martin Falck	John Wintermute	Final version
July 16, 2001	Martin Falck	Peter Dwyer	Revised final per TAC comments

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1. Purpose of Document

The purpose of this document is to define the Concept of Operations for the TravInfo® enhanced data fusion system. It will also define what is meant by the term 'data fusion' and where it fits in to the overall TravInfo® system concept. It is designed to provide an understanding of the operations of the data fusion system, including the TIC, and how each component will contribute to fulfilling the TravInfo® mission. Additionally, it should provide a solid frame of reference for the design documentation to follow.

This is part of a series, shown below, of deliverable documents to be submitted as the enhanced Data Fusion process evolves and system design details are developed.

Since this document precedes the architecture and design tasks, the specifics of some system elements are discussed only at a high level. Where this is the case, a more in-depth treatment of these topics will be included in future design documents as details are worked out.

This is the final document for deliverable #3-4a for functional requirement 3.3.1.

2. Introduction

The Data Fusion system discussed in this document refers to the systems and activities at the TravInfo® Traveler Information Center (TIC) plus an Internet-enabled system to receive event input from other agencies. At the TIC, the data fusion system includes all hardware, software, and staff needed to process and integrate data into the required formats for traveler needs, public sector needs, and current and future ATIS services. The data fusion system extends to and includes the interfaces with data dissemination servers.

2.1 Background

Operations at the TIC began during the initial TravInfo® phase. PB assumed responsibility for the TIC when it began its role as the TravInfo® contractor in November, 2000. All current TIC operations personnel are employees of PB/Alltech, a PB subsidiary. Z^3 was also retained as the on-site systems administrator.

PB is maintaining the TransView system as the Basic Data Fusion System. This will continue until some point after the initial deployment of the Interim Enhanced system, when the Configuration Control Board (to be established) makes the determination to switch over from the Basic to the Enhanced system.

This document builds upon the Data Fusion Needs Assessment Document, deliverable #3-3a, March 27, 2001, previously submitted by PB that discussed the key inputs and tools needed for

Data Fusion. The Data Fusion Needs Assessment also introduced some concepts at a high level that are expanded upon in this document.

2.2 Structure of Document

Sections 4 and 5 comprise the key part of this document. Each covers data fusion operations with a different approach. Section 4, *Operations*, provides an operational explanation of what the data fusion process, and the TIC in particular, is all about. It includes a section on link data fusion, which is actually part of the Data Collection system but is included here for completeness. Section 5, *System Overview*, discusses each aspect of the data fusion system in greater detail. This structure does result in some repeated information, as each discussion of a given area is from a different viewpoint. This will allow reviewers from different disciplines to better review the information.

A note on terminology – the term "event" is used in this document as a generic term that covers traffic or transit incidents, construction, and special events.

3. References

Data Fusion Needs Assessment Document, PB, deliverable #3-3a, March 27, 2001.

PB TravInfo® Contractor Conformed Proposal, August, 2000.

TravInfo® TIC Standard Operating Procedures, deliverable #1-1f, November 21, 2000.

Discussions with TIC administrative and operational staff.

4. Operations

This section is an operational discussion of how incident data is fused, the operations of the TIC, and the processing of fused link data.

TravInfo® data will be fused in the following ways:

- Manually entered by the TIC operators, using the EventOI software
- Manually modified and verified event data from the Agency Webserver via Framework messages
- Semi-automatically, including weather and facilities data in event messages
- Semi-automatically, by modified event data collected by the Data Collection system
- Automatically, accepting as verified certain data received from TravInfo member agencies
- Automatically, with software applications to fuse link data from the Data Collection system via Framework messages.

4.1 TravInfo® Traveler Information Center (TIC)

The TIC is the heart of the TravInfo® Data Fusion system. The stated mission of the TIC, according to the TIC Operations Manager, is "to disseminate accurate, timely, clear and concise traveler information for all people in the 9 county Bay Area, 24 hours a day, 7 days a week."

Data fusion, under the PB TravInfo® design, primarily means people fusing data. The TIC relies on human expertise; the computer systems are tools to assist the operators in performing their jobs in an accurate and timely manner. TIC operators are trained to utilize all available data sources and tools provided to develop accurate and timely incident data. TIC operations are documented in the TIC Standard Operating Procedures, deliverable #1-1f, November 21, 2000. The Enhanced system will allow for more specific operational guidelines, which will be included in a revised Procedures document. However, there is no precise formula for verification and data entry, and operator actions will still be governed largely by on-the-job training and experience.

The existing TIC organization, shown in Figure 4.1, has been successful and is not expected to change for the Enhanced system.

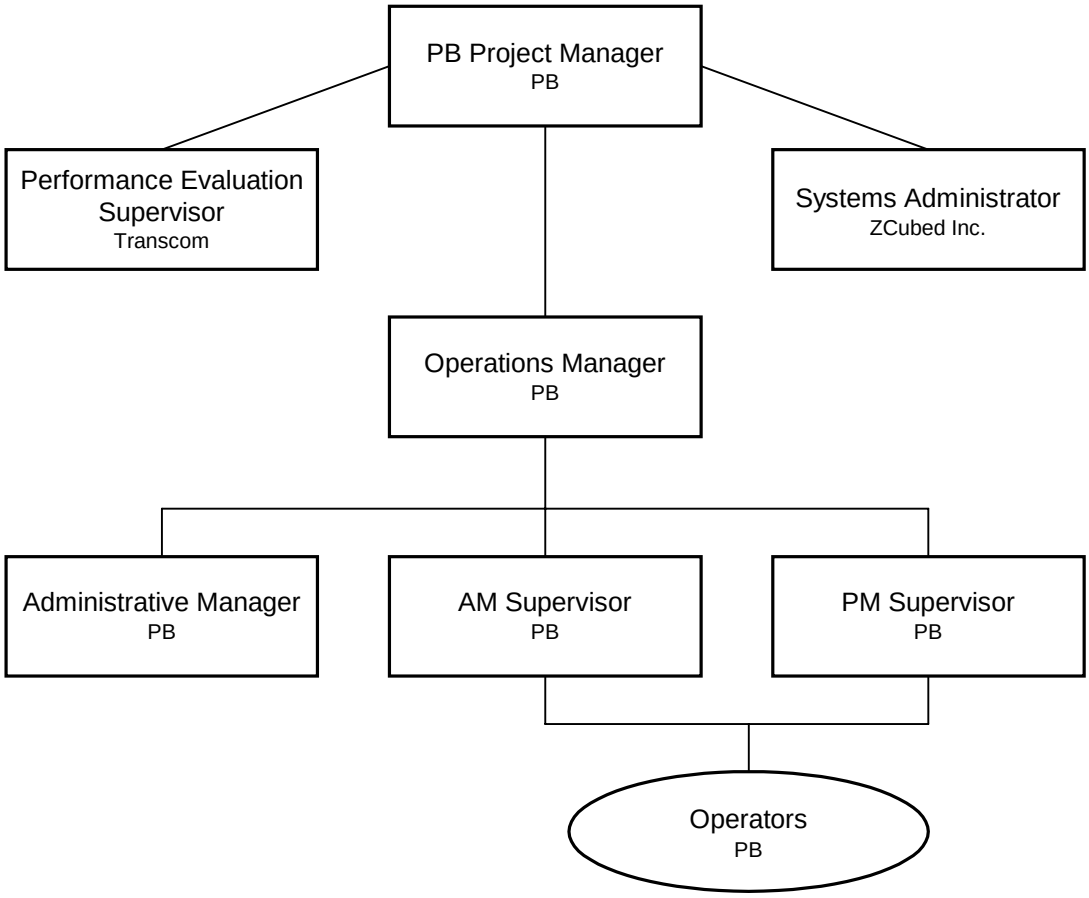

Figure 4.1 Existing TIC Organizational Chart

Current plans call for enlargement and physical redesign of the TIC. In addition to the operators in the TIC itself, there will also be an operator at a workstation co-located in the new Caltrans Transportation Management Center (TMC).

4.2 Enhanced System Overview

The Enhanced Data Fusion system is planned for implementation as an interim version in late 2001, with the final system planned for summer 2002. The interim system will consist of a set of existing software tools, modified as necessary for TravInfo®. The final system will provide upgraded versions of those applications and the Agency Webserver application.

The Enhanced Data Fusion System will be installed and eventually tested with the enhanced Data Collection and Data Dissemination systems. This will be the permanent operational system at the TIC.

4.3 Data Flow

All automated external data enters the Data Fusion system through the TIC server. From there it is routed to the TIC operator workstations. The workstations will contain software applications to receive this data, format it in a graphical display, and notify the operator. The operator, using various resources, will verify the event and complete the data entry if necessary. Operators may also initiate an event based on their own sources. Completed event data is then submitted back to the TIC server and forwarded out to the TravInfo® network. This data flow is illustrated in Figure 4.2.

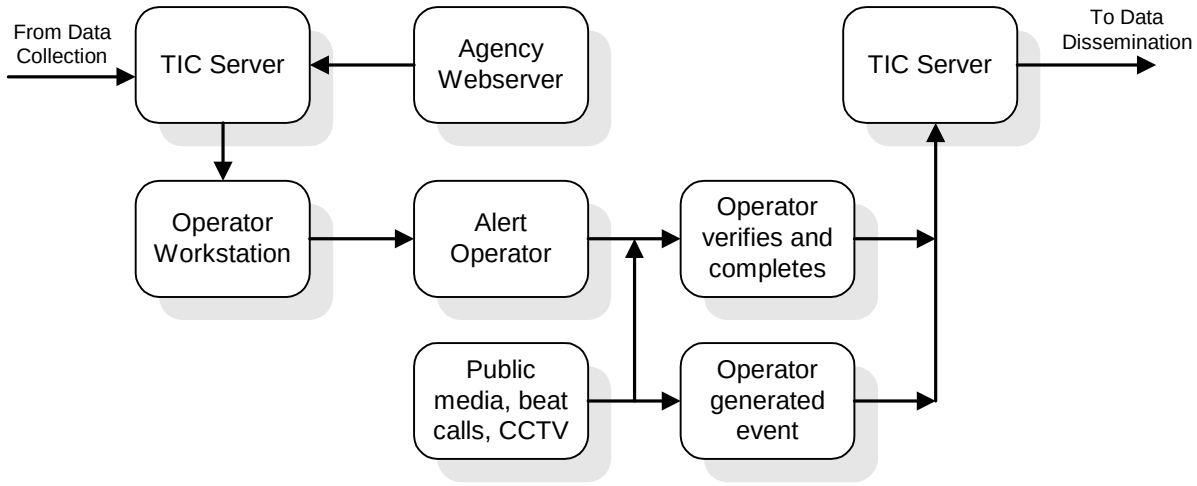

Figure 4.2 High Level Data Flow

4.4 Inputs

TIC operators will obtain event information from a number of sources, including:

- *Workstation alerts* – (Semi-automated) Event information from the Data Collection system, including CHP CAD data, will not generally contain all details required to populate the Data Dissemination databases. These events will generate alerts on the TIC operator workstations. Event data manually input by other agencies through the Agency Webserver (discussed below) will also generate alerts. Operators will then complete and verify the event data using the various tools at their disposal, e.g., roadwork and facilities database utilities.

  Until the automated data feed from CHP CAD is completed, the data will be entered manually from information gathered on the CAD monitor.

- *Link status data from detectors* – (Automated) The visual link status utility (known as LinkOI) will provide a quick summary of link status information, such as speed and travel time. This can serve as both an indicator of potential traffic problems as well as confirmation of a problem reported from another source.

- *TV, Radio, Internet* – (Manual) The TIC operators will also utilize the public media as sources of relevant information relating to road conditions, weather, and other situations which may affect travel throughout the region.

- *CCTV* – (Manual) A monitor, viewable to all operators, displays the various CCTV feeds coming into the TIC. This will enable both the notification to the TIC of a slowdown as well as confirmation of traffic conditions reported from other sources.

- *Phone,Fax,E-mail* – (Manual) TIC personnel maintain a set of contacts with various organizations that provide or confirm event and road status information on request. While there is no formal Road Warrior program, incident calls received at the TIC will be entered as unconfirmed incidents, and will not be disseminated unless verified by other means.

- *Facility Data* – (Manual) Facility locations, Park and Ride data, etc. will be accessible to the TIC operators.

4.5 Operator Procedures

TIC operators are provided with a set of daily procedures to assure a smooth start-up, operation, and close of each shift. These procedures will be modified when the Enhanced Data Fusion system is implemented. The following is a summary of procedures that will apply with the new system, extracted from the TIC Standard Operating Procedures, deliverable #1-1f, dated November 20, 2000, and modified to reference Enhanced system components:

- Meet with the operator you are replacing to discuss the items already in the system.

- Log in to the TIC workstation.

- Review active events in your area of responsibility on the Event Tracking application to either update or remove them.

- View the Map Viewer display to become familiar with active events and construction in your area of responsibility, and look for slowdowns.

- View link status information for your area of responsibility with the LinkOI application for new incidents and verification of expected slowdowns.

- Make your beat check calls.

- Respond to on-screen alarms in a timely manner, providing event verification, event update, or event aging responses, as appropriate.

- Monitor TV/Radio/Internet for backup details relating to incidents active in your area. Check with the Slowdown Desk to confirm that information using sensors and/or cameras. Include the details in your report.

- When your relief comes on duty, discuss currently active events in the assigned area. If you are not relieved, pass the information to the person covering your area or supervisor.

4.6 Event Processing

Events will be entered at the TIC operator workstation using the EventOI application. The EventOI application provides an interface for the operators to enter incident data with a minimum of keystrokes.

Unconfirmed events and events from external sources can be entered and saved. These can be recalled but do not go beyond the workstation until the operator confirms the event.

Once the event is confirmed, the data is stored in the TIC server databases and a set of Framework messages are published to provide event information to the data dissemination system. The Framework messages also make the event visible at all TIC operator workstations as well as any subscribing application on any gateway server.

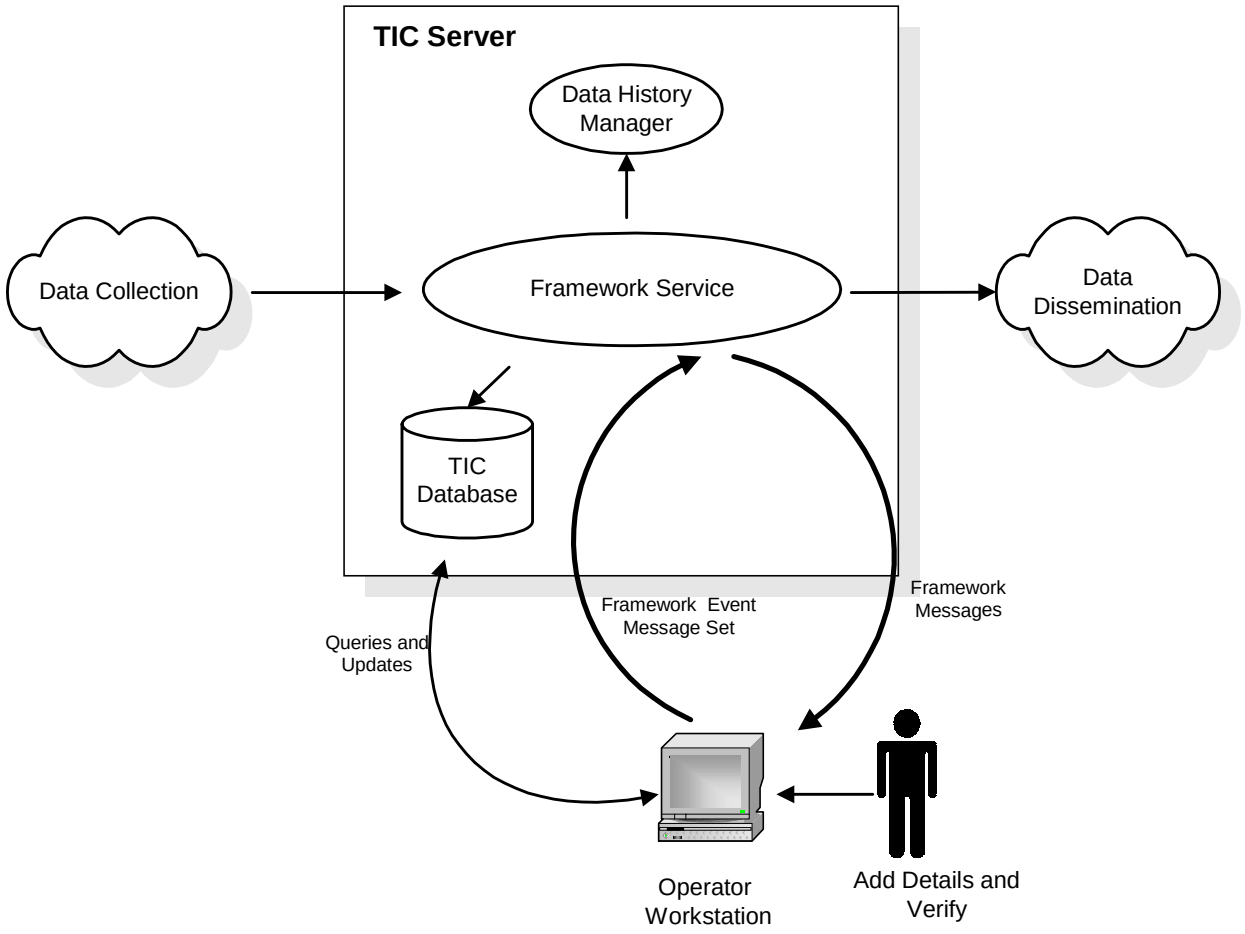

Figure 4.3 Data Fusion Process

The CHP CAD will continue to be a primary source of incident information. Since the CHP CAD data cannot currently be parsed, the operators will continue to view the CHP reports and use that information to enter events into the TIC workstation. At some future point it is expected that the CAD interface will be automated. Under this scenario, the EventOI screen will be automatically populated with the CAD data, triggering an alarm to prompt the operator to complete and verify the event.

Operators will also be able to view link speeds and travel times using the LinkOI. This tool provides a quick, color-coded summary of all links for which data is being reported on.

Incidents and link status can also be viewed on the Map Viewer.

4.7 Event Verification

Events from external sources will be verified by the TIC before an event becomes “official” and it is accepted into the TravInfo® system. Operators will use any combination of the various

sources discussed above as supporting verification to assure the high degree of accuracy that is vital to the success of TravInfo®.

Any event that cannot be initially verified will remain within the TIC system as a potential event and visible to the operators until it is either verified or deleted. It will not, however, be made available to the dissemination system until an operator upgrades its status to verified.

4.8 Workstation Alerts

Many operator actions are initiated by alarms generated by the Event Tracking software. The *Alarm* function handles incoming alarms for the various types of events, and allows the user to take action depending on the type of alarm and access. The different types of alarms are:

- *Event Alarms* are displayed when event information is received from an external source, requiring operator input and verification. Alarms apply to Highway Incidents and Construction, Transit Incidents and Construction, and Special Events. As alarms are acknowledged on a workstation, other workstations will no longer receive alarm notification for that incident. Alarms can be disabled by operator preference.

- *Alarms for Weather Events* will be generated upon receipt of weather data from the Data Collection system.

- *Pending Event Alarms* notify operators about any Open events that have exceeded the Preset time threshold past the previously established Estimated Duration. Pending alarms apply to all event types.

- *Active* alarms are notifications of scheduled events that are close to reaching a start date and time. The *Active* alarm will display based on a defined duration before the start date and time of the planned event.

Active alarms are received for events that were originally planned, such as scheduled Construction and Special Events within the Alarm window for further processing.
To confirm Active events, the operator will click on the *Confirm* button within the *Alarm* window to confirm the alarm. The *Event Tracking View* opens in create mode with common fields automatically filled in. The remaining event information is then added and sent as a new event. If *Ignore* is selected for a notification, it is removed from the alarm screen but will appear again after a specified interval.

Operators can modify certain filter criteria that limit the amount of alarms that must be acknowledged.

4.9 Map Viewer

The Map Viewer provides a geographic information system (GIS) based display of links, various ITS assets, and active and scheduled events. Operators can plot and view events on the Map Viewer. The operators can also open a map, zoom into a particular roadway where there is an active incident, and obtain a brief summary of information about that incident.

Links for which detector data is available will be color coded according to current status to give operators a quick visual summary of roadway conditions.

The system will have the capability to create and store map views that may be shared by all users. These will cover individual geographic areas, specific roadways, common congestion spots, etc. The precise views created will be determined by the operations staff.

4.10 Closing Events

Events are closed when the TIC operator verifies, using one of the above discussed sources, that any activity affecting traffic conditions has concluded or been cleared. The operator will then select that event in the Event Tracking system and mark it as closed. The event will also be shown as closed on all other TIC workstations. Closed event status will be entered into the Event Tracking system for dissemination, and removed from the active event list.

Events are defined with an expected duration when they are entered into the system. When this time expires and the event has not yet been closed, the operators will be notified by an alarm and prompted to take some action. Then, they may extend the event, close it, or ignore the alarm, in which case the alarm will again be triggered after a specified period of time.

Events with a closed status will be maintained in the active database for a specified period and then moved to an archive database.

4.11 Outputs

Event actions performed by TIC operators initiate two major actions of significance to the TravInfo® system. The first is writing the event details to the TIC databases. This provides two benefits – storing the active event information for update and retrieval and maintaining an historical record of all events for later analysis.

The second output, and the key for TravInfo® operations, is the publication of Framework messages. These are distributed throughout the TravInfo® network and formatted for the various system outputs by the Data Dissemination system.

4.12 Distribution of Effort

Each workstation will be assigned responsibility for a particular section of the TravInfo® geographical area. The workload may be distributed in other ways as well, such as assigning roadwork and slowdowns to one operator and incident handling to another. All workstations, however, will be capable of viewing all events and performing all tasks. This configuration will be flexible enough to allow operations to be controlled by a single workstation, on evenings and weekends or if a particular workstation is down.

Once the TIC is enlarged and redesigned, the operators will be working more as a “team,“ not segregated as they are currently. This concept is being developed by the Operations Manager, and further details will be provided in future design documents.

4.13 Automated Link Data Fusion

The TravInfo® system will receive detector data from a number of sources. This data will be generated by a variety of devices, and will provide spot and link volume, occupancy, and speeds. The TravInfo® Data Collection sub-system will be responsible for the collection, validation, and initial processing of this data, and for converting it into a form that is usable by the other system elements and ISPs. There are a number of stages in this process. The first is the collection of the "raw" data from the source systems. As this data is read, the values will be converted into standard units and will be subjected to various validation elements. If the data fails validation, it will typically be flagged as bad and not used by later steps. The next stage is a process called "Automated Link Data Fusion" (ALDF), which will be discussed below. The final stage is dissemination of the processed inputs and ALDF outputs.

As the name "Automated Link Data Fusion" implies, this process generates data on links. Since many of the data inputs are for spot detectors, part of the initial conversion process is to determine the link that the data will be applied to. This can result in links with multiple data points from a single source, as well as data from other sources. The ALDF process is responsible for determining which data is the best for each link. Each link will store a volume, occupancy, actual speed, and synthesized speed, although in some cases not all of these will be available. Synthesized speed is based on algorithms that use occupancy, volume, or both to estimate the current speed. These algorithms are not as effective as a real speed sensor (loop traps, radar or other direct measurement technology), but allow for estimation of conditions in areas where these devices do not exist.

Each time new data is received by the system, it is time stamped and stored. Each source is configurable such that the storage can result in old data being overwritten or all recent reading being averaged to generate the value used. The fusion process is executed periodically and will select the best source from those that are currently providing data on each link. The sources will always include historical data (see below), plus any others that may be active for the link. Two other common sources will be considered for inclusion in this system. The first is a simple algorithm that will back fill small gaps in the link coverage by averaging nearby (adjoining) links data. The second uses computer traffic models to predict conditions on the link network based on partial data.

One of the cornerstones of the ALDF process is the use of historical data. These values act as the final fallback indication of current conditions, as well as an element of the abnormal congestion determination algorithm. Historical data in the system is dynamic, and it will automatically adapt over time to reflect changing link conditions based on other source data. The historical data is stored in a standard relational database. Each link has data stored based on a number of factors. The first of these is the day type. Day types are used to group information based on common characteristics. For example, weekend traffic is different than Monday, which is different from mid-week or Friday. The data is stored based on the time of day. For example, each day might be divided into 15-minute blocks, and each data value would only be used (and smoothed) within that time.

Typically the smoothing factor specified for altering the historical data is set such that a single (one day) instance of unusual conditions would have minimal effect on the new value. Logic can be incorporated in the ALDF process that discards changes to links that have had incidents registered, but this is only effective if the incident is assigned to a link, which is not required by the TMDD standard.

Link status reported by the Data Collection system will be available to TIC operators through the LinkOI application and viewable as differing colors on the Map Viewer.

4.14 Performance Monitoring

Performance evaluation is primarily concerned with the accuracy and timeliness of data provided by the Data Dissemination system. The TIC does, however, include a performance evaluation team on-site to monitor operations through sampling of collection, fusion, and dissemination data. Performance metrics will be maintained and periodically reported to MTC.

5. System Overview

This section provides the physical view of the Data Fusion system. It contains a brief technical description of the various software applications and processing elements discussed in the Operations section above. A more in-depth explanation of these software programs will be included in the Data Fusion design documents to be delivered in the future.

5.1 Basic System Summary

TravInfo® utilizes the TransView system to collect, fuse, and disseminate its data. Fusion occurs as a series of decision algorithms based on collected data. TransView applications used within the TIC (Traffic Information Manager, Transit Information Manager, Backup Congestion Manager, etc.) rely on access to a Sybase database, for look up tables used in applications and to store data for current use and historic archive as well as dissemination to participants.

For incident data, TIC operators manually enter incident descriptions at workstations running TransView's many incident managers. The data is directly uploaded to the database. Whether the information will be available to the public will depend on the activation of the confirmation flag. If the flag is turned off, the information is not published but is kept alive in the system for use. Usually, this is used as a staging method for operators.

For Caltrans Traffic Operating System (TOS) data, the system is more automated. Data collected from the listener UDP port of TransView's TOS Input Processor is shifted and averaged to produce a set of speed and congestion values for each segment of road. Upon receiving TOS link data, TransView correlates link IDs to sensor IDs (many to one relation). For each sensor, link data is determined to be valid or invalid as assigned by Caltrans (IFSS). The Caltrans TOS data packets include a valid/invalid flag. If a link has valid data, its values are stored in an internal array assigned to its related sensor and taken as an average with other links assigned with the same sensor. If a link has invalid data, it is by-passed and not used for averaging. Sensors that average zero are likewise removed from consideration and are not published. (This is the case when IFSS has incorrectly assigned flags.)

There is a special case currently implemented in regards to TOS. Due to the high number of failed TOS detectors, MTC requested that TravInfo® test whether performance is improved without using the sensor concept. In the "BAY AREA" portion of the TravInfo® data tree (of which is disseminated to participants), valid speed and congestion values are published without additional processing.

5.2 Enhanced System Summary

The Enhanced Data Fusion System, as stated in PB's proposal, will be based on PB's regional system design, similar to the system developed by PB for TRANSCOM in the New York City area. It is designed to provide the operators with the capability of getting events into the system accurately with a minimum of typing.

5.3 Data Sources

TravInfo® data sources that are currently received at the TIC and are expected to continue include:

- California Highway Patrol Computer Aided Dispatch (CAD) - incident data/roadwork updates
- Caltrans Traffic Operating System (TOS) - speed and congestion data
- Caltrans Closed Circuit Television (CCTV) - congestion / incident data
- Caltrans - roadwork
- BART - incident / delay times
- MUNI - elevator status / service interruptions and changes
- WWW - weather/Caltrans District 5 roadwork
- Caltrans Bay Bridge Dispatch - incident and congestion data for all Caltrans operated bridges in the Bay Area
- Golden Gate Bridge - incident and congestion data
- SF Police Department - incident data
- Oakland Police Department - incident data
- San Jose Police Department - incident data
- Monterey CHP - incident data
- Transitinfo.org - transit data
- Caltrain – train delay information
- Media sources - with Agency confirmation
- Various venues - planned event information.

New data sources that will be available as part of the final Enhanced Data Fusion system are as follows:

- Fused link data from the Data Collection task via Framework messages
- Unverified events entered through the Agency Webserver.

5.4 Data Exchange (Framework)

Data throughout the TravInfo® system will be exchanged via a standards compliant messaging system developed by PB, known as the Framework. For organizational and design purposes, the Framework is included as part of the Data Fusion task even though it also has functions

within the Data Collection and Data Dissemination tasks. The Framework is a flexible message exchange mechanism for use within ITS networks. It is responsible for ensuring the timely delivery of published messages within the defined network. The Framework consists of a suite of software components, supported by a database.

The main Framework components are the Framework Control and the Framework Service. The Framework Control is an OCX (a standard software component format), which provides the properties, methods, and events for use by client applications to log in and out of the Framework and publish and subscribe to messages. It also notifies an application when a Framework event has happened, such as when a publication has been received or when communications with another machine has failed. The Framework Service maintains an internal subscription database and is responsible for routing messages to their proper destination. The Framework does not validate the contents of a message, however, it is concerned only with the transport and routing of messages.

The Framework message set is based on TMDD standard messages and is defined in a database available system-wide. This database contains a listing of available messages, the fields making up the message, a data dictionary defining each data element, and supporting lookup tables.

Within the Framework context are client and server applications. There are two types of client applications - publishers and subscribers. Applications, which generate data and need to supply it to other applications, are publishers. Such applications publish messages to the Framework according to a schedule agreed upon by the publisher and subscribers. Subscribers subscribe to receive specific messages. A single application can be both a subscriber and publisher.

5.5 TIC Systems

5.5.1 Network

From a systems viewpoint, the TIC will consist of a local area network containing a central server connected to the TravInfo® wide area network, and five operator workstations in the TIC and one in the Transportation Management Center, as illustrated in Figure 5.1. The server will maintain connections with the rest of the TravInfo network as well as Internet access.

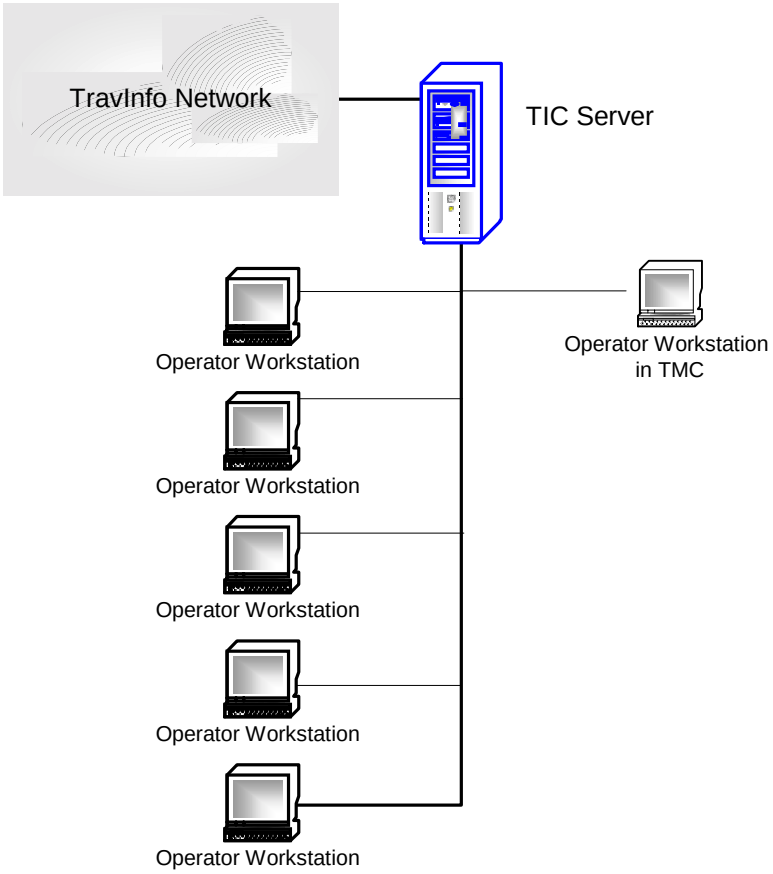

Figure 5.1 Proposed TIC Architecture

The server will be redundant to maximize uptime. The network will be maintained by a systems administrator. The design and implementation of the enhanced system network, as well as any future systems upgrades, will be fully supported by the PB systems engineering group.

Communication between the operators at the TIC and TMC will occur using e-mail or voice. However, any modification to an incident made by one operator will be distributed via the Framework and appear on the other operator's screen. Incomplete or unverified events will be flagged accordingly and will not be distributed beyond the TIC.

5.5.2 Application Overview

The application software at the TIC will play a key role for inputting event information into the TravInfo® system, then formatting and routing it to be available for dissemination. There will be six major software components to the TIC system, which will be described in more detail below:

- Logon
- Event Tracking

- Map Viewer
- Link OI
- Object Editor
- Data History Manager
- Facility Data Viewer

Each of these, with the exception of Logon, communicates with the rest of the system via Framework messages. There will be various other utilities available on the TIC workstations as well. However, these are not key operational components and so will be discussed later in the design documentation.

5.5.3 Logon

Access to the TIC workstation applications is controlled by a Logon utility. This utility requires operators to log on with a valid user account before gaining access to any workstation applications. The user account will be verified against a security database containing user account information and access rights to each of the TravInfo® software applications. User accounts and privileges will be maintained by the TIC systems administrator. Once a login is accepted, a list of user rights is returned to the workstation. This controls access to each application, while providing the flexibility of allowing any user to log on from any workstation. It will also provide an audit trail of operator actions.

5.5.4 Event Tracking

The TIC Event Tracking application provides a standard interface for entering, viewing, and distributing events as part of the TravInfo® system. Below is a summary of capabilities:

- Roadway Incidents: Track incident events that are highway-related, such as jack-knifed tractor-trailer or heavy traffic on a particular interstate facility.
- Transit Incidents: Track incident events that are transit-related, such as a stalled train.
- Roadway Construction: Track scheduled roadway construction projects, such as overhead sign repair, or overnight roadwork.
- Transit Construction: Track scheduled transit-related construction projects, such as signal or broken rail repairs.
- Special Events: Track scheduled special events, such as parades, sporting events, or any other events that affect traffic or transit facilities.
- Map Interface: Provides a link to the Map Viewer so incidents can be plotted and viewed.

- Alarms: Notify operators of new events and events past their estimated end time. Alarms can be filtered with various criteria to reduce the volume.

- Reports: Provides formatted event history reports.

- Weather: Notify operators of weather issues that may affect traffic.

Using the EventOI incident tracking browser, an operator can view either opened or recently closed events. Events can be sorted by source agency name or date and time. The operator can also filter out events that were created by other organizations. The Event OI Summary Report allows the operator to view a report based on filtering and sorting criteria. The report can be filtered by date and time, reporting organization, responding organization, state or facility. The report can also be sorted by date and time, responding organization, reporting organization, facility or state.

5.5.5 Map Viewer

The Map Viewer will provide a detailed GIS display of the nine county TravInfo® system area as well as a higher level (less detailed) display of an extended area. This display can be dynamically configured to display various ranges of area and layers for each view. Operators will have the capability to pan and zoom so as to display the desired granularity of objects on the map. By turning on and off various layers, the operator can focus on those map objects of interest, e.g., mileposts, incidents, etc. The Map Viewer also displays link status using different colors to indicate the average detected speed on that link.

5.5.6 Link OI

The Link Operator Interface (LinkOI) application provides the operator with a quick summary of current speeds, and possibly travel times, for each link defined in the system. Link data is received into the Data Fusion system via Framework messages generated by the Data Collection system. This application will be available at all times in a separate on-screen window. The precise content available on the LinkOI screen will be defined in the draft Detailed Design document.

5.5.7 Object Editor

The Object Editor is a workstation application that allows the creation and modification of ITS objects relevant to TravInfo®, including geo-referencing them on the Map Viewer interface. Objects are system assets, such as links, exits, and mileposts. Links are sections of roadway, usually between exits or intersections, for which incident and traffic information can be reported. Exits and mileposts are specifically plotted points that are used to define links. The Object Editor will communicate internally with the local workstation Map Viewer. Completed transactions will be stored in system databases and distributed via the Framework to other TravInfo® components.

The Object Editor will be used during system development to populate the databases before the system goes live, and any time an object is added, modified, deleted, or has a status change.

Privileges to modify system objects will be restricted to key staff, such as the system administrator and operations supervisors.

5.5.8 Data History Manager

The Data History Manager is an application running on the TIC server that subscribes to all relevant Framework messages and stores the received data in the server databases. These databases serve as the official record of all event and periodically averaged link data that is processed through the TravInfo® system. A procedure will be developed to archive this data off of the server for permanent storage. The storage specifications will be address in the data fusion design information.

5.5.9 Facility Data Viewer

The TIC will maintain current databases containing various facility data that the operators will need to use. Examples of facility data include airport and rail station parking locations, access, and capacity; park & ride lot locations, access, and capacity; regional recreational facilities. A utility will be provided to enable the operators to quickly view and update this information.

5.6 Agency WebServer

The Agency Webserver will be an internet-based tool that will provide a method for authorized users from participating agencies, special event venues, etc., to enter incident, construction, and/or special event information from any internet-enabled workstation. This Agency WebServer will allow a wide agency audience and participation with the construction, special event, and incident reports for the system without burdening the agency with large numbers of dedicated workstations. It will contain similar functionality to the Event Tracking component. Currently, it is assumed that these will be external users, so TIC operators will be prompted to provide some input and verification before the event is accepted into the system.

5.7 Data Fusion Output

Information will come out of the Data Fusion system primarily in the form of Framework messages. Framework messages, discussed in greater detail in Section 5.4, are strictly formatted and standards compliant. These formats will be well documented so that there will be a common understanding of this data throughout the TravInfo® system. Documentation will be available both in database format for applications to access automatically and in system documentation for TravInfo® technical development personnel to work from.

The Data Fusion system will also generate data stored in system databases and reports that may be accessed externally.

5.8 TIC Server

The TIC server is the gateway between the TIC local area network and the rest of the TravInfo® network. It will receive Framework messages from the TravInfo® network (from the Data Collection system) and route them to TIC workstations. Framework messages generated at TIC workstations will be sent to the TIC server to be sent out to the other servers on the network.

The server will consist of two fully redundant computers with automatic failover software, so the failure of one machine will not cause TIC server functions to be lost.

5.9 TIC Databases

The TIC server will house a series of databases to store all event data and periodic fused link status data. The databases include the Framework message database as well as other relatively static data used for internal lookups and picklists on operator interface screens.

Static databases will be created manually during system development, and placed under PB's configuration control system. This data will be imported into the operational databases when the system is installed. The system administrator will manually update static data as needed. Procedures will be implemented to assure than any on-site data modifications are duplicated in the configuration databases.

Closed event data will be moved out of the active database into a history database. An operational plan will be defined for eventually archiving this older data off of the TIC servers onto CD-ROM or other long-term storage media.

Glossary

CHP CAD California Highway Patrol Computer Aided Dispatch. A major source of TIC incident data.

DATEX An ITS standard data format, developed to facilitate interoperability between ITS systems.

Framework The planned message exchange system for TravInfo data

Framework Message A DATEX compliant data stream containing formatted event and link data

TIC Traveler Information Center. The operational hub of the Data Fusion system, located in the Caltrans building in Oakland.

TMDD Traffic Management Data Dictionary. An ITS standard for data elements

TMC Transportation Management Center. Caltran's operations center, located in the Caltrans building in Oakland.

TOS Traffic Operating System. Caltrans system for reporting speed and congestion data.